GEOLOGY.—*The Wolfcamp Series (Permian) and new species of fusulinids, Glass Mountains, Texas.*[1] Charles A. Ross, Peabody Museum, Yale University. (Communicated by Herbert H. Ross.)

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INTRODUCTION

The Wolfcamp Series in the Glass Mountains, Tex., is represented by a sequence of diverse lithologies and includes a regional unconformity. A detailed study of these strata reveals that two formations can be recognized in the field and that both units are within the "Zone of *Pseudoschwagerina*" (Fig. 1). Each formation has a distinct and characteristic fusulinid fauna. The Nealranch formation embraces the upper part of beds originally called Wolfcamp by Udden (1917) in the Wolf Camp Hills and is renamed to retain this widely used name for the time-stratigraphic unit, the Wolfcamp Series. The Lenoxhills formation unconformably overlies the Nealranch formation and is the upper formation of the Wolfcamp Series in the Glass Mountains. It was in part included in the Wolfcamp formation of King (1931), where it crops out in the western Glass Mountains and is now known to be present across the southern escarpment of the eastern Glass Mountains, and is the lower 200 to 300 feet of the Hess formation of Udden (1917). The correlation of these stratigraphic units with strata in other regions is determined on the basis of their fusulinid faunas.

The exact placement of the top of the Pennsylvanian system in the Glass Mountains has long been a major controversy. Fusulinid faunas of Cisco (Virgil) age are known from strata as high as the "grey limestone" of King (1931 and 1937). In the Wolf Camp Hills the Nealranch formation (300 to 470 feet thick) unconformably overlies the "grey limestone" and contains the oldest *Schwagerina* and *Pseudoschwagerina* faunas thus far discovered in the Glass Mountains. The boundary between the Permian and Pennsylvanian systems is taken at this unconformity. The Nealranch formation is truncated and has been removed for some distance east of the Wolf Camp Hills by pre-Lenoxhills erosion. At Gap Tank, about 10 miles east of the Wolf Camp Hills, 90 feet of Nealranch strata have been preserved from pre-Lenoxhills erosion in a faulted syncline which formed before Lenoxhills deposition.

In the western part of the Marathon Basin at the foot of the Lenox Hills, 6 miles west of Marathon, faulted and folded strata locally contain *Pseudoschwagerina uddeni* (Beede and Kniker), *Schwagerina puguncu-lus*, n. sp., and *Triticites uddeni* Dunbar and Skinner. Thus the Nealranch formation was deposited in the western part of this area prior to the last major tectonic pulse of the Marathon orogenic belt.

The Wolf Camp Hills, Gap Tank, the foot of the Lenox Hills, and probably the base of the Hess ranch horst have the only known outcrops of the Nealranch formation in the Glass Mountains.

The Lenoxhills formation unconformably overlies the Nealranch, Gaptank, and older strata of the Marathon orogenic belt. The type section of the Lenoxhills formation is in the Lenox Hills west of Marathon, where it is composed of 130 feet of conglomerate at its base succeeded by 160 feet of sandstone, clastic limestone, and shale. To the southwest in the Lenox Hills the entire formation changes facies into conglomerate. Further to the southwest at Dugout Mountain, the conglomerate changes facies into sandstone and shale (150 feet thick) and finally into limestone and shale. Throughout the Glass Mountains the Lenoxhills formation is marked by a persistent basal conglomerate, but the strata above change facies within short distances.

Northeast of the Lenox Hills, the formation changes into a shale facies and is thin (120 feet) just west of Iron Mountain. At Leonard Mountain the Lenoxhills formation forms the southern and eastern facies. Here the shale units intertongue eastward into

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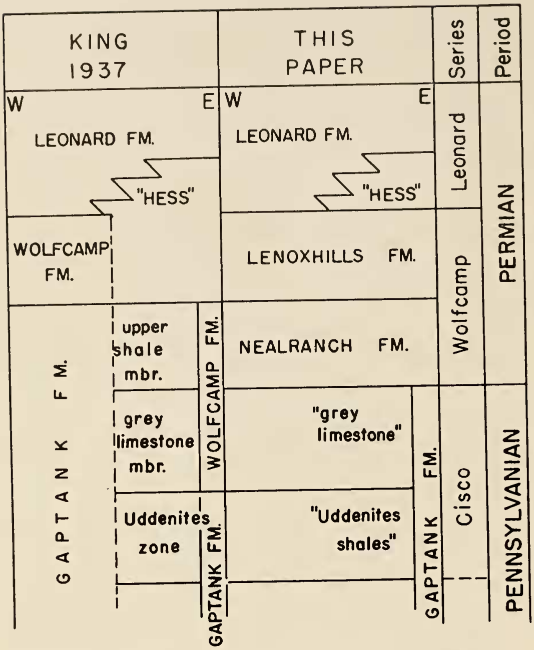

Fig. 1.—Stratigraphic terminology as used by King (1937) and in this paper. In the table W represents the western Glass Mountains and E the eastern Glass Mountains.

biohermal limestones which form the eastern face. Farther to the east from the Hess ranch house to the vicinity of the Wolf Camp Hills these biohermal strata intertongue into silty thin-bedded limestones, 200 to 300 feet thick. Eastward from the Wolf Camp Hills, the thin-bedded limestones of the Lenoxhills formation intertongue with red and varicolored shales, and green cross-bedded sandstones of the marginal marine facies. Throughout much of this eastern area the basal conglomerate of the Lenoxhills formation fills valleys cut into the limestone beds of the Gaptank formation.

The Leonard formation unconformably overlies the Lenoxhills formation in the western Glass Mountains. Locally pre-Leonard erosion has removed most of the Lenoxhills formation and as at the southwest end of Dugout Mountain and in the northern part of the Lenox Hills the base of the Leonard formation rests on the truncated edges of the folded and faulted beds of the Marathon orogenic belt. In the eastern part of the Glass Mountains the Leonard formation overlies the limestone and shale of the Lenoxhills formation with no apparent unconformity, being rather a sharp change in facies into thick units of thin bedded limestone.

The "grey limestone" of King (1931) contains the youngest Pennsylvanian fauna in the Wolf Camp Hills and includes *Triticites comptus* n. sp., *T. ventricosus* (Möller), *T. pinguis* Dunbar and Skinner, and *T. koschmanni* Skinner (Fig. 2).

The fusulinids which characterize and are restricted to the Nealranch formation in the Wolf Camp Hills include: *Triticites uddeni* Dunbar and Skinner, *Schwagerina emaciata* (Beede), *S. puguncuius*, n. sp., *Pseudoschwagerina uddeni* (Beede and Kniker), *Paraschwagerina acuminata* Dunbar and Skinner, and *P. gigantea* (White). In addition the following species range into the Nealranch formation: *Triticites ventricosus* (Möller), *T. pinguis* Dunbar and Skinner *T. koschmanni* Skinner, *Pseudoschwagerina beedei* Dunbar and Skinner, and *P. texana* Dunbar and Skinner.

Fusulinids which characterize and are restricted to the Lenoxhills formation in the western Glass Mountains are: *Schwagerina extumida*, n. sp., *S. lineanoda*, n. sp., *S. dispansa*, n. sp., *S. laxissima* Dunbar and Skinner, *S. bellula* Dunbar and Skinner, *Pseudoschwagerina tumidosus*, n. sp., and *P. robusta* (Meek). In addition the following species range into the Lenoxhills formation: *Schwagerina compacta* (White), *S. tersa*, n. sp., *S. crebrisepta*, n. sp., *S. nelsoni* Dunbar and Skinner, *S. knighti* Dunbar and Skinner, *S. diversiformis* Dunbar and Skinner, *Paraschwagerina plena*, n. sp., *Pseudoschwagerina beedei* Dunbar and Skinner, *P. texana* Dunbar and Skinner, *Parafusulina linearis* (Dunbar and Skinner), and *P. schucherti* Dunbar and Skinner.

Descriptions of the new species mentioned above follow.

Triticites comptus, n. sp.

Pl. 1, figs. 1–3, 5

Description—This elongate, subcylindrical species commonly reaches a length of 9.2 mm and a diameter of 2.0 mm in six to seven volutions. The tightly coiled compact early whorls, regularly and highly folded septa, rudimentary

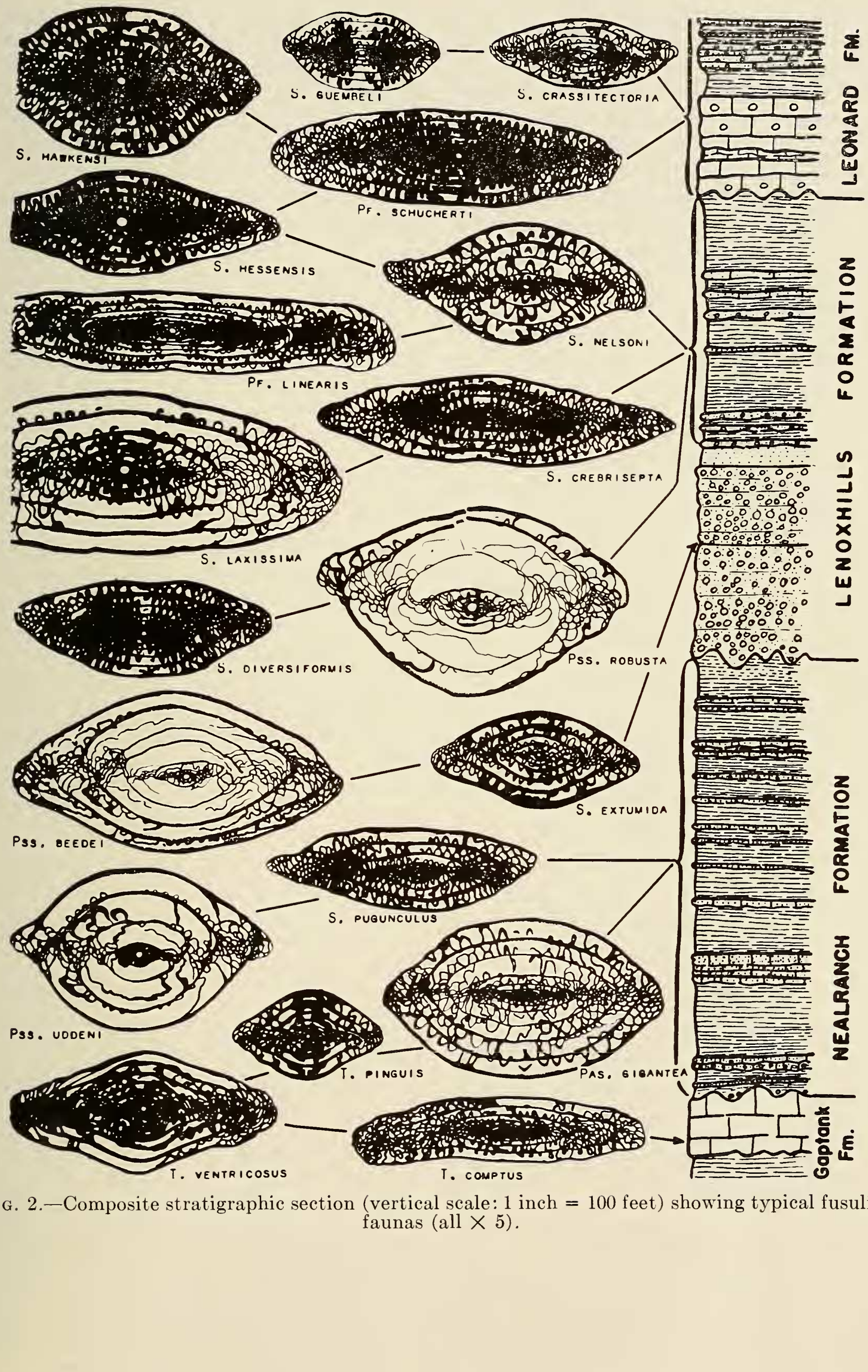

Fig. 2.—Composite stratigraphic section (vertical scale: 1 inch = 100 feet) showing typical fusulinid faunas (all × 5).

chomata, and curved axis of coiling are distinctive of this species (Pl. 1, figs. 1, 5).

In specimens examined the proloculi are small, averaging 0.10 mm outside diameter. The first two or three volutions are tightly coiled and elongate, attaining form ratios of 2.5 to 3.2. Succeeding volutions are higher and become greatly extended along the curved axis of coiling; the form ratio in the sixth or seventh volution generally exceeds 4.5. The long polar extremities are narrow and unevenly rounded and overlap irregularly the preceding half volution (Pl. 1, figs. 2, 5). The chambers increase slightly in height laterally away from the midplane. The shape of the lateral slopes is regular but tends to be convex in most volutions.

The wall is composed of a thin tectum and a thin, indistinct keriotheca. The wall thickness gradually increases from 0.005 mm in the proloculus to 0.05 mm in the sixth or seventh volution. The wall thickness remains nearly constant from the midplane to the polar extremities.

The septa are thin and highly fluted into closely spaced, nearly regular folds, which extend laterally across the entire chambers (Pl. 1, fig. 5). As seen in the sagittal section (Pl. 1, fig. 3), the septa are extremely numerous per volution and are inclined steeply from the antetheca towards the floor of the chamber. The folds often reach the top of the chamber and have steep nearly parallel flanks and acutely rounded crests.

The tunnel, narrow in the first three or four whorls, expands gradually in later whorls. The tunnel angle measures 18° in the first volution, 25° in the third, and 40° in the fifth or sixth whorl. The tunnel is well defined by either low chomata or breaks in the closely spaced, highly folded septa throughout all but the outer volution (Pl. 1, figs. 1, 5). The path of the tunnel includes the midplane of the shell. The antetheca beneath the tunnel is often thinner than the antetheca on the lateral slopes and apparently has been slightly resorbed by the tunnel. Chomata are rudimentary in the shell and form as thin, high deposits connecting adjacent septal folds of the successive chambers (Pl. 1, fig. 3). Secondary axial deposition, common in the first two or three whorls, gives this portion of the shell a dense, dark appearance. These deposits form as septal thickening in the lateral regions of the early whorls.

Discussion.—*Triticites comptus*, n. sp., is similar in shape and general internal structures to *T. joensis* Thompson, *T. osagensis* Newell, *T. tenuis* Merchant and Keroher, *T. plicatula* Merchant and Keroher, *T. ohioensis* Thompson, and *T. collus* Burma. From these species *T. comptus* differs in lacking well-defined chomata and having more regularly and highly folded septa across the shell.

The stratigraphic occurrence of this highly specialized species of *Triticites*, *T. comptus*, indicates that it is probably similar to the undescribed species mentioned by Thompson (1957, p. 300) from the lower Virgil of the Midcontinent region. The species takes its name from the Latin *comptus*, meaning ornamented, elegant, refer-

TABLE OF MEASUREMENTS

YPM specimens

	Volution	20550	20551	20555	20554	20552
radius vector	0	.05mm	.05mm	.06mm	.04mm	.05mm
	1	.07	.08	.11	.08	.10
	2	.10	.12	.19	.12	.16
	3	.20	.20	.30	.20	.23
	4	.31	.30	.48	.30	.32
	5	.53	.48	.70	.47	.47
	6	.77	.70	1.00	.65	.62
	7	—	.98	—	.90	.88
half length	1	.19mm	.19mm	.28mm	.12mm	12*
	2	.30	.38	.45	.38	16*
	3	.57	.62	1.00	.65	22*
	3	1.15	1.01	1.90	1.20	23*
	5	2.40	2.00	3.40	1.40	27*
	6	3.60	2.40	5.30	1.90	32*
	7	—	4.60	—	3.90	29*
form ratio	1	2.7	2.4	2.5	1.5	
	2	3.0	3.2	2.4	3.2	
	3	2.8	3.1	3.3	3.2	
	4	3.3	3.3	4.0	4.0	
	5	4.5	4.2	4.9	3.0	
	6	4.7	3.4	5.3	2.9	
	7	—	4.7	—	4.3	
tunnel angle	1	26°	18°	—	—	
	2	28	24	24°	18°	
	3	30	26	30	20	
	4	32	29	44	24	
	5	—	39	45	28	
	6	—	43	—	20	
	7	—	—	—	—	
wall thickness	0	.003mm	.007mm	.02mm	.007mm	
	1	.003	.009	.005	.008	
	2	.005	.01	.007	.01	
	3	.01	.01	.01	.01	
	4	.02	.02	.005	.01	
	5	.02	.03	.01	.02	
	6	.05	.04	.03	.06	
	7	—	.05	—	.05	

* Number of septa.

ring to the close, regularly folded septa seen in thin-section.

Occurrence.—Upper part of the Gaptank formation in the Wolf Camp Hills, at Leonard Mountain, and in the syncline four miles west of Marathon, Tex.

Holotype.—YPM 20551, Yale Peabody Museum, illustrated Pl. 1, fig. 5, Gaptank formation, Wolf Camp Hills.

Schwagerina crebrisepta, n. sp.

Pl. 4, figs. 1–3, 5

Description.—This large, elongate species commonly reaches 13 mm in length and 3 mm in diameter in seven volutions. In thin section specimens show a marked division between early and late growth patterns; the young shell is tightly coiled with secondary deposits and the adult shell is loosely coiled with secondary deposits in irregular patterns along the axis.

The proloculus of the holotype (Pl. 4, fig. 3) is 0.10 mm outside diameter and is spherical. The size of the proloculi in other specimens examined is remarkably consistent averaging 0.10 mm in diameter with little variation. The first three to four volutions are tightly coiled and growth during this stage is mainly along the axis. Form ratios of 3.0 to 4.0 are common in the first four volutions. The fifth volution shows a distinctive increase in chamber height as well as a considerable increase in length. The form ratio remains constant or decreases slightly in this volution, but in later volutions it increases reaching as much as 4.3 in the seventh one. The chamber height in the adult whorls increases gradually in the center of the shell, but in the lateral and polar extremities the height increases greatly giving the shell a subcylindrical shape.

The wall is thin in the proloculus, 0.005 to 0.01 mm thick, and in the early whorls reaches only 0.03 mm. The adult whorls thicken gradually to about 0.10 mm in the last whorl.

The septa are thin and highly folded (Pl. 4, fig. 3). These folds have steep sides, reach to the top of the chambers, and are rounded to subacute at their crests in the adult whorls. In the early whorls the folds are flattened across their crests. Throughout the shell, the closely spaced folds show a regular pattern, each septum having folds of uniform height. The septa form parallel to the axis of coiling.

The tunnel angle ranges between 15° and 25° in young shells, but increases gradually to a width of 30° in the sixth volution and is one-third the height of the adult chambers. The tunnel path deviates as much as 10° out of the midplane of the shell. Chomata are rudimentary in the early whorls and completely lacking in the adult whorls. Secondary deposits fill the young volutions except near the midplane and in the first three adult whorls these deposits fill the axial extremities. The septa in the remaining portions of the shell show evidence of secondary deposition at the crests of their folds. False walls are common in the specimens examined; however, they are not present in whorls with axial fillings.

TABLE OF MEASUREMENTS

YPM specimens

	Volution	20634	20632	20631	20630
radius vector	0	.05mm	.05mm	.05mm	.05mm
	1	.12	.11	.09	.09
	2	.19	.20	.12	.11
	3	.30	.32	.20	.21
	4	.52	.51	.32	.40
	5	.80	.86	.60	.70
	6	1.15	1.20	1.00	1.10
	7	1.50	1.50	1.40	1.45
half length	1	.25mm	.22mm	.11mm	.10mm
	2	.65	.50	.38	.20
	3	1.15	1.10	.52	.50
	4	2.10	1.95	.90	1.15
	5	3.10	2.80	1.85	2.15
	6	4.65	4.00	3.40	2.80
	7	6.40	5.75	4.20	4.70
form ratio	1	2.0	2.0	1.2	1.1
	2	3.4	2.5	3.2	1.8
	3	3.8	3.4	2.6	2.4
	4	4.0	3.8	2.8	2.9
	5	3.9	3.3	3.1	3.1
	6	4.0	3.3	3.4	2.5
	7	4.3	3.8	3.0	3.2
tunnel angle	1	20°	18°	15°	24°
	2	20	17	18	28
	3	25	22	28	28
	4	30	25	24	25
	5	30	21	17	23
	6	29	28	23	30
	7	—	—	—	—
wall thickness	0	.01mm	.01mm	.01mm	.005mm
	1	.01	.01	.008	.005
	2	.01	.02	.01	.008
	3	.02	.03	.01	.01
	4	.04	.05	.03	.03
	5	.09	.08	.03	.09
	6	.11	.12	.06	.11
	7	.10	.12	.08	.10

Discussion.—*Schwagerina crebrisepta* is similar in general internal structure to *S. franklinensis* Dunbar and Skinner but has distinct young and mature regions, a larger size per volution, and notable axial deposition. *S. complexa* Thompson is similar in size and ontogeny but has greater inflation in the adult chambers, less tightly and less regularly folded septa, and is more fusiform. The specific name *crebrisepta* from the Latin, many septa, refers to the abundant septa seen in thin sections of this species.

Occurrence.—Lenoxhills formation in western Glass Mountains, Tex., reworked specimens in lower part of the Leonard formation.

Holotype.—YPM 20634, Yale Peabody Museum, illustrated Pl. 4, fig. 3; from Lenoxhills formation, north of Hess ranch horst.

Schwagerina dispansa, n. sp.

Pl. 2, figs. 7–12

Description.—The shell of this species commonly attains a length of 9.5 mm and a diameter of 3.5 mm in seven to eight volutions. The outer two or three whorls are greatly extended along the axis and give the shell long winglike projections. The inner whorls are shorter and more loosely coiled. The regularly folded septa, early globose volutions and later extension of the shell along the axis, and medium to small size distinguish this species.

In specimens examined, the proloculi are aspherical to spherical and range in size from 0.04 to 0.16 mm outside diameter. As shown in Pl. 2, fig. 8, the initial whorl is often highly inflated and irregular, with a form ratio of 2.0. The succeeding two or three volutions have thick fusiform outlines and increase in height and length proportionally, retaining form ratios of 2.0. In the outer two or three whorls the chambers extend laterally along the axis as long extended polar extremities, and the form ratio increases to 3.0 (Pl. 2, fig. 7, 12). The poles of these mature volutions are evenly rounded and the lateral slopes concave. The chambers in the early whorls are nearly constant in height from the center to the poles, but in later whorls they show a great increase in height in the extended polar extremities.

The wall is composed of a tectum and a thick, coarsely alveolar keriotheca. The wall remains constant in thickness from the center of the shell to the polar extremities. It is commonly 0.01 mm thick in the proloculus and gradually increases to 0.10 mm thickness in the last volution. In specimen YPM 20628 (Pl. 2, fig. 7) the wall in the minute proloculus is 0.003 mm thick.

The septa are strongly and regularly folded throughout the shell. The folds are symmetrical with nearly straight sides and rounded crests and they are evenly spaced across the entire chambers. The basal margin of folds of one chamber generally touches the opposing folds in adjacent chambers. Cuniculi are not observed in these shells, but as shown in specimen YPM 20627 (Pl. 2, fig. 10) the formation of the tunnel results in resorption of the base of the septa and this gives the impression of one well-developed cuniculus on each side of the tunnel.

TABLE OF MEASUREMENTS

YPM specimens

	Volution	20628	20629	20625	20626
radius vector	0	.04mm	.12mm	.16mm	.14mm
	1	.09	.20	.27	.27
	2	.10	.39	.47	.41
	3	.19	.70	.72	.65
	4	.30	1.15	1.10	.90
	5	.52	1.55	1.35	1.30
	6	.95	1.80?	—	1.70?
	7	1.35	—	—	—
	8	1.60	—	—	—
half length	1	.09mm	.45mm	.45mm	.65mm
	2	.20	.85	.72	.90
	3	.32	1.50	1.35	1.30
	4	.60	2.55	2.00	1.90
	5	1.00	3.65	2.95	2.95
	6	1.60	5.35	—	4.30
	7	2.80	—	—	—
	8	4.90	—	—	—
form ratio	1	1.0	2.2	1.7	2.4
	2	2.0	2.2	1.5	2.2
	3	1.7	2.2	1.9	2.0
	4	2.0	2.2	1.8	2.1
	5	1.9	2.4	2.2	2.3
	6	1.7	3.0?	—	2.5
	7	2.1	—	—	—
	8	3.1	—	—	—
tunnel angle	1	28°	17°	21°	22°
	2	30	27	23	27
	3	32	24	17	27
	4	32	31	—	36
	5	24	—	—	—
	6	29	—	—	—
	7	38?	—	—	—
wall thickness	0	.003mm	.01mm	.007mm	.02mm
	1	.003	.01	.02	.02
	2	.008	.03	.02	.03
	3	.01	.03	.07	.03
	4	.02	.10	.08	.06
	5	.04	.15	.08	.08
	6	.07	.10	—	.09?
	7	.09	—	—	—
	8	.10	—	—	—

The straight tunnel is of medium width, the tunnel angle is 20° in the first whorl with a gradual increase to 35° in the fourth or fifth whorl. The septa are resorbed to about one-half chamber height to form the tunnel. Chomata are rudimentary and are present only on the outer surface of the proloculus. Secondary deposits occur in about two-thirds of the specimens examined, and may be thick in the axial region or thin coatings on the septa throughout the shell. Falsewalls are common in shell chambers which lack axial fillings (Pl. 2, fig. 7, 12).

Discussion.—*Schwagerina dispansa* is a rare species that is seemingly closely related to *S. knighti* Dunbar and Skinner. *S. knighti* is much larger and has several more highly globose volutions than does *S. dispansa*, but variation within *S. knighti* is poorly known. Axial deposits when present in *S. dispansa* are apparently distinctive. *S. dispansa* is similar in shape to *S. nelsoni* Dunbar and Skinner but is smaller when mature and has a considerably different ontogeny.

The species takes its name from the Latin *dispansa*, meaning stretched out, and refers to the extended polar extremities in the mature shell.

Occurrence.—Lenoxhills formation in western and central Glass Mountains, Tex.

Holotype.—YPM 20628, Yale Peabody Museum, illustrated Pl. 2, fig. 7; from the Lenoxhills formation, north of the Wolf Camp Hills.

Schwagerina extumida, n. sp.

Pl. 3, figs. 4–7, 9

Description.—This thickly fusiform species commonly attains a length of 9 mm and a diameter of 4 mm in seven to eight volutions. The form of the early whorls is globose and chamber height increases proportionally faster than axial elongation until the fifth volution. The later whorls become more elongate and have concave lateral slopes in the seventh and eighth volutions. The poles are small and acutely rounded. The wall in the outer whorls is extremely thick for shells of this size but it changes thickness appreciably from a maximum near the center to a minimum near the poles, a distinctive feature in this species (Pl. 3, fig. 6).

The proloculi are subspherical and in specimens examined range between 0.14 and 0.18 mm outside diameter. The first two whorls are low and in most specimens have a form ratio of 2.4 in this portion of the shell. The third, fourth, and fifth whorls increase notably in height but relatively little in length, giving form ratios of about 1.8. The chamber height remains constant, or nearly so, across the entire shell in these volutions. The sixth, seventh, and eight whorls show a considerable increase in length. The height of these chambers increases toward the poles to give the lateral slopes a slight concave outline (Pl. 3, figs. 6, 7).

The spiral wall is composed of a well-defined tectum and a thick, coarse keriotheca. In the center of the shell the wall thickness increases notably in the last two whorls to a maximum of 0.19 mm. In the lateral regions, the wall thins evenly toward the poles.

The septa are regularly and highly folded throughout the shell. They are closely folded in

TABLE OF MEASUREMENTS

YPM specimens

	Volution	20648	20649	20646	20650
radius vector	0	.07mm	.09mm	.08mm	.09mm
	1	.12	.17	.12	.19
	2	.21	.31	.23	.38
	3	.36	.52	.45	.59
	4	.57	.70	.70	.90
	5	.71	1.20	1.00	1.30
	6	1.21	1.70	1.40	1.60
	7	1.65	2.00	—	—
half length	1	.20mm	.25mm	.25mm	.45mm
	2	.45	.50	.50	.80
	3	.65	.75	.70	1.20
	4	.95	1.20	1.30	1.75
	5	1.35	2.00	2.10	2.65
	6	2.15	3.30	—	3.80
	7	3.10	4.60	—	—
form ratio	1	2.4	1.5	2.1	2.4
	2	2.1	1.6	2.2	2.1
	3	1.8	1.4	1.6	2.0
	4	1.7	1.7	1.8	1.9
	5	1.9	1.7	2.1	2.0
	6	1.8	1.9	2.0	2.4
	7	1.9	2.3	—	—
tunnel angle	1	15°	20°	25°	22°
	2	15	20	25	22
	3	15	20	20	20
	4	20	20	20	20
	5	20	20	20	—
	6	15	—	—	—
	7	—	—	—	—
wall thickness	0	.008mm	.01mm	.007mm	.01mm
	1	.009	.015	.008	.03
	2	.015	.02	.012	.06
	3	.025	.07	.03	.07
	4	.080	.09	.08	.09
	5	.110	.15	.11	.12
	6	.180	.17	.14	?
	7	.190	.19	—	—

the first five volutions but the folds are spaced slightly farther apart in the outer whorls where the axis becomes elongate. Also the septa are somewhat farther apart in the outer whorls (Pl. 3, fig. 6) and the center of the septa lags behind the lateral portions during growth.

The tunnel is narrow throughout the shell. The tunnel angle reaches 25° in only one specimen examined, the average is about 20°. The tunnel is well defined by secondary deposits on the basal margin of the septa (pseudochomata) and occasionally as minor axial fillings (Pl. 3, fig. 9).

Discussion.—The rapid thinning of the wall toward the poles and the placement and type of secondary deposits make this species distinct from most other species of *Schwagerina*. *S. hessensis* Dunbar and Skinner is similar, however the large proloculus, elongate form, and nearly constant wall thickness of that species are distinctly different. *S. hawkinsi* Dunbar and Skinner is larger, more globose throughout the shell, and has secondary deposits reinforcing the septa throughout the entire shell. White (1932, Pl. 6, fig. 6) illustrates a form which is similar to this species and calls it *Triticites plummeri*, however that form is smaller, has well-developed chomata in the early whorls and is only superficially similar to *S. extumida*. Species derives its name from the Latin *extumida*, meaning swelled up.

Occurrence.—Lower part of the Lenoxhills formation in Hess ranch horst.

Holotype.—YPM 20649, Yale Peabody Museum, illustrated Pl. 3, fig. 9; Lenoxhills formation; Hess ranch horst.

Schwagerina lineanoda, n. sp.

Pl. 2, figs. 1–6

Description.—This small, subcylindrical species commonly reaches a length of 7.5 mm and a diameter of 2.5 mm in six volutions. The shape of the shell remains nearly constant during growth with only a gradual elongation along the axis of coiling. The poles are bluntly rounded and succeeding whorls form smoothly rounded poles without over hanging lips.

In specimens examined the proloculi are commonly aspherical and range in size from 0.16 to 0.24 mm outside diameter. The early whorls are low and establish the general shape of the shell by the second volution. The succeeding volutions increase gradually in height. The chambers, however, show an increase in height toward the polar extremities which causes gradual elongation of the shell along the axis and gives the shell a more cylindrical form in the outer volutions. The lateral slopes are convex throughout the shell. The form ratio increases from about 2.0 in the first or second whorl to about 3.0 in the sixth.

The wall is fairly thick for shells of this size and increases from 0.009 mm thick in the proloculus to 0.06 mm in the sixth volution. The wall is composed of a tectum and a finely alveolar keriotheca. It remains constant in thickness from the center of the shell along the lateral slopes to poles.

The septa are thick and tightly fluted into close, regular folds. In thin sections these folds are subcircular in outline, the greatest width of the folds being slightly above the floor of the chamber (Pl. 2, figs. 1–4). In axial section the folds appear as series of knots aligned on the floor of the chamber. The septal folds lap over

TABLE OF MEASUREMENTS

YPM specimens

	Volution	20677	20675	20676	20674
radius vector	0	.12mm	.07mm	.11mm	.08mm
	1	.22	.20	.19	.12
	2	.33	.30	.29	.20
	3	.48	.48	.42	.30
	4	.72	.72	.70	.50
	5	1.00	.95	.95	.65
	6	1.20	1.20?	—	—
half length	1	.55mm	.30mm	.40mm	.20mm
	2	1.00	.70	.70	.45
	3	1.60	1.00	1.35	.80
	4	2.50	1.70	2.15	1.15
	5	3.30	2.45	2.80	1.60
	6	3.90	3.10	—	—
form ratio	1	3.3	1.5	2.1	1.7
	2	3.0	2.3	2.4	2.3
	3	3.3	2.1	3.2	2.7
	4	3.5	2.4	3.1	2.3
	5	3.3	2.6	2.9	2.5
	6	3.2	2.6	—	—
tunnel angle	1	28°	30°	28°	33°
	2	29	34	30	35
	3	29	35	35	32
	4	30	33	32	—
	5	—	—	—	—
	6	—	—	—	—
wall thickness	0	.008mm	.009mm	.009mm	.01mm
	1	.01	.02	.01	.01
	2	.03	.02	.02	.02
	3	.05	.04	.03	.04
	4	.07	.05	.07	.06
	5	.05	.07	.05	.07
	6	.06	.06	—	—

one another in the lateral regions of the early whorls, but this is not so in the central region. Cuniculi have not been observed. Although the septa touch each other (Pl. 2, fig. 5), the septal wall apparently is not resorbed at the point of junction. In the fourth and later whorls, the septa are widely spaced in many specimens and do not always touch one another.

The tunnel is wide in this species, 28° in the first volution, and gradually increases to about 35° in the third or fourth. Beyond the fourth whorl where the septa become widely spaced, the tunnel is difficult to trace in thin sections. Rudimentary chomata are common on the outer surface of the proloculus and in the first whorl, but are lacking in the rest of the shell. Secondary thickening of the septa in the axial region is common in adult specimens, but generally lacking in immature specimens (compare Pl. 2, fig. 1, with fig. 4, both specimens from the same sample).

Discussion.—*Schwagerina lineanoda*, n. sp., is similar to *S. crassitectoria* Dunbar and Skinner, but is more elongate, has more rounded septal folds, and a thicker spiral wall. *Parafusulina linearis* (Dunbar and Skinner) is more elongate, has heavier axial fillings, and more regularly folded septa.

The morphologic position of *S. lineanoda* between *Parafusulinea linearis* and *S. crassitectoria* suggests the three species are more closely related than previously suspected. The name, *lineanoda* from the Latin, having lined knots, refers to the appearance of the subround septal folds in thin section.

Occurrence.—Lenoxhills formation at Dugout Mountain and north of the Wolf Camp Hills, Tex.

Holotype.—YPM 20675, Yale Peabody Museum, illustrated Pl. 2, fig. 3; Lenoxhills formation, north of Wolf Camp Hills.

Schwagerina puguncuius, n. sp.

Pl. 1, figs. 8, 9, 12, 13

Description.—This large, fusiform species reaches a length of 11 mm and a diameter of 4 mm in six to seven volutions. The flat lateral slopes, small pointed poles, and highly folded septa are distinctive (Pl. 1, fig. 13).

The proloculi in specimens examined range between 0.12 and 0.26 mm outside diameter and are generally spherical. The first two or three volutions have low, long chambers which give form ratios between 2.0 and 3.7 depending on the individual specimen. The succeeding volutions become elongate along the axis of coiling. The chamber height increases markedly from the midplane toward the poles, and the lateral slopes are straight or slightly convex; in YPM 20777, however, one slope is slightly concave in the last volution. After the third whorl the volutions expand evenly and slowly having an early tightly coiled portion and late more loosely coiled portion that gives the shell a zoned appearance.

The wall gradually thickens from 0.01 mm in the proloculus to 0.10 mm in the seventh volution. It is composed of a tectum and well developed keriotheca with coarse alveoli. The keriotheca thins gradually toward the poles and is almost completely lacking around the poles.

TABLE OF MEASUREMENTS

YPM specimens

	Volution	20719	20716	20777	20718
radius vector	0	.06mm	.07mm	.13mm	.11mm
	1	.12	.12	.21	.17
	2	.28	.26	.38	.30
	3	.50	.48	.65	.50
	4	.80	.62	1.00	.80
	5	1.15	1.10	1.42	1.20
	6	1.45	1.60	1.75	—
	7	—	1.90	—	—
half length	1	.30mm	.45mm	.45mm	.35mm
	2	.60	.80	.75	.70
	3	1.10	1.30	1.45	1.20
	4	2.20	1.80	2.20	2.15
	5	3.10	3.00	3.50	3.00
	6	5.20	4.50	5.00	—
	7	—	5.50	—	—
form ratio	1	2.5	3.7	2.0	2.1
	2	2.1	3.0	2.0	2.3
	3	2.2	2.7	2.2	2.4
	4	2.8	2.9	2.2	2.7
	5	2.7	2.7	2.5	2.5
	6	3.6	2.8	2.8	—
	7	—	2.9	—	—
tunnel angle	1	15°	15°	17°	23°
	2	15	17	21	19
	3	15	21	24	20
	4	17	19	25	32
	5	—	27	—	—
	6	—	—	—	—
	7	—	—	—	—
wall thickness	0	.01mm	.01mm	.02mm	.01mm
	1	.01	.02	.03	.02
	2	.02	.04	.03	.03
	3	.04	.08	.07	.03
	4	.07	.09	.10	.06
	5	.10	.10	.09	.09
	6	.10	.11	—	—
	7	—	.10	—	—

The septa are thick and are highly fluted from pole to pole (Pl. 1, fig. 12, 13). The sides of the folds are steep and nearly parallel along their basal margins. The crests of the folds are acutely rounded and extend to the top of the chambers. Small septal pores are common and are evenly distributed over the septal face.

The tunnel angle ranges between 15° and 32° in specimens examined and seems to expand gradually from a narrow beginning to its greatest width in the fourth or fifth volution. The path of the tunnel is slightly irregular, varying about 5° out of the midplane. Rudimentary chomata are common on the outer surface of the proloculus and in the first and second whorls. Slight secondary deposition is common along the axis as septal thickening which generally does not completely fill the chambers. False walls are not observed.

Discussion.—This species is similar in general size and form to *Paraschwagerina gigantea* (White) but lacks the tightly coiled juvenarium of that genus. *Schwagerina pugunculus* is similar in size to *S. hessensis* Dunbar and Skinner but lacks the thick walls, closely spaced, dense septa, and the early inflated whorls of that species. *S. pugunculus* differs from *S. diversiformis* Dunbar and Skinner, *S. compacta* (White) and *S. crassitectoria* Dunbar and Skinner by the lack of heavy axial deposits and differences in ontogeny.

S. thompsoni Needham is smaller and more inflated in its later volutions than is this species, but in other respects these two species appear closely related. At a given volution *S. elkoensis* Thompson is about half the size of *S. pugunculus*. *S. complexa* Thompson, which is similar in size and shape to *S. pugunculus*, has more highly inflated early adult chambers, more irregularly folded septa, less pointed poles and is smaller per volution.

Study of the Dunbar and Skinner collection shows that Dunbar and Skinner refer specimens of this species from the Nealranch formation (at Wolf Camp) to *S. franklinensis* Dunbar and Skinner. However, *S. franklinensis* is more slender and delicate in appearance and has a different ontogenetic growth. (*S. franklinensis* is present in the Glass Mountains but considerably higher in the stratigraphic section.) The species takes its name from the Latin *pugunculus*, short dagger, and refers to the short daggerlike appearance of the lateral slopes.

Occurrence.—Nealranch formation in the Wolf Camp Hills and at the base of the Lenox Hills, Tex.

Holotype.—YPM 20716, Yale Peabody Museum; illustrated Pl. 1, fig. 13; Nealranch formation, Wolf Camp Hills.

Schwagerina tersa, n. sp.
Pl. 1, figs. 4, 6, 7, 10, 11

Description.—This small, fusiform species commonly attains 7.5 mm in length and 2.5 mm in diameter in six to seven volutions. Throughout the shell the shape is ellipsoidal, the poles gently rounded, and lateral slopes convex.

In specimens examined, the proloculi range in size from 0.08 to 0.16 mm outside diameter, and the first two whorls are low and extend rapidly along the axis of coiling. After the shell has reached a length of 0.8 mm, the next volution increases markedly in height giving the shell the appearance of two growth stages. The lateral slopes are convex throughout the shell and the chambers remain constant in height from the center to the pole. Succeeding volutions overlap at the poles, but without forming a prominent lip; instead the underside of the whorls joins with and continues the profile of the preceding half volution (Pl. 1, fig. 4, 6, and 11).

The wall is composed of a tectum and a coarsely alveolar keriotheca. The wall in the proloculus is 0.007 mm thick and increases gradually to 0.09 mm in the sixth or seventh volution, and shows little or no decrease in thickness laterally away from the center of the shell.

The septa are highly fluted into closely spaced folds which extend to the top of the chambers (Pl. 1, fig. 4, 6, 11). The folds have steep flanks and gently rounded crests. Septal folds of one chamber overlap opposing folds of the preceding chamber only near the poles.

The tunnel is of medium width in the early whorls and gradually expands in later whorls; it measures 25° in the first volution and 40° in the fourth. The path of the tunnel follows the midplane of the shell with little deviation. Chomata, if present, are found only in the first and second volutions and on the outer surface of the proloculus, and are always rudimentary. Other secondary deposits are apparently lacking in this species.

Discussion.—*Schwagerina tersa* is a nondescript species which has all the characteristics of an idealized primitive *Schwagerina* species. These features include the medium to small size,

TABLE OF MEASUREMENTS
YPM specimens

	Volution	20685	20684	20680	20682
radius vector	0	.07mm	.08mm	.08mm	.04mm
	1	.11	.13	.19	.09
	2	.19	.27	.32	.13
	3	.30	.43	.55	.24
	4	.48	.67	.80	.46
	5	.70	.95	1.10	.71
	6	.90	1.35	—	1.00
	7	—	—	—	1.35
half length	1	.23mm	.30mm	.42mm	.20mm
	2	.50	.55	1.10	.45
	3	.70	1.20	1.70	.55
	4	1.35	1.90	2.10	.95
	5	2.20	2.95	3.35	1.45
	6	3.20	3.70?	—	2.20
	7	—	—	—	2.95
form ratio	1	2.1	2.3	2.2	1.8
	2	2.6	2.8	3.4	3.5
	3	2.3	2.8	3.1	2.3
	4	2.8	3.1	2.6	2.1
	5	3.1	2.7	3.0	2.0
	6	3.6	?	—	2.2
	7	—	—	—	2.2
tunnel angle	1	25°	24°	26°	27°
	2	31	29	45	28
	3	29	34	48	?
	4	38	30	46	29
	5	55?	—	—	—
	6	—	—	—	—
	7	—	—	—	—
wall thickness	0	.008mm	.006mm	?	.006mm
	1	.008	.009	.01mm	.008
	2	.01	.01	.02	.01
	3	.02	.02	.03	.01
	4	.04	.05	.06	.03
	5	.06	.07	.08	.04
	6	.07	.08	—	.08
	7	—	—	—	.09

the even, elliptical outline of the volutions, the regularly folded thin septa, and the wide tunnel. It is similar to *S. emanciata* (Beede) but is larger, lacks well developed chomata, and has more closely and regularly folded septa. *S. grandensis* Thompson and *S. colemani* Thompson are about the same size and shape as *S. tersa,* but the walls of the early whorls in those species are thicker and the septal folding less intense. *S. vervillei* Thompson is similar in general shape, size, and interior structure but is notably smaller per volution.

This species incorporates a number of closely similar specimens from a thick stratigraphic sequence.

Occurrence.—Lenoxhills, Leonard and Word formations, Tex.

Holotype.—YPM 20684, Yale Peabody Museum, illustrated Pl. 1, fig. 6; from Lenoxhills formation, southwestern side of Leonard Mountain, Glass Mountains, Tex.

Pseudoschwagerina tumidosus, n. sp.
Pl. 3, figs. 1–3, 8

Description.—This large elongate species reaches a length of 11 to 14 mm and a diameter of 5 to 8 mm in six volutions. The apices of this form are rather acutely pointed for a *Pseudoschwargerina* and lack the knobs common in some of the more highly inflated forms.

The proloculus is relatively large (Pl. 3, figs. 1–3, 8) and average outside diameter is 0.25 mm. YPM 20761 (Pl. 3, fig. 2) from a different locality, has a smaller proloculus of 0.18 mm, outside diameter. YPM 20760 (Pl. 3, fig. 8) has an irregular proloculus but other specimens have near spherical proloculi. The juvenarium has three to four volutions and a form ratio of 2.2, but the adult shell inflates within a quarter volution to a form ratio of 1.6 to 1.7. The form ratio gradually diminishes to 2.4 in the last volution. The height of the last volution is considerably lower than those of the early adult volutions (Pl. 3, fig. 1, 3, 8).

The spiral wall is 0.03 to 0.09 mm thick in the juvenarium, decreases in thickness slightly in early adult whorls, but finally attains a thickness of 1.1 to 1.2 mm in the last volution. It is finely alveolar throughout the shell.

The septa are numerous, highly folded, and thick (probably as a result of secondary deposition) in the juvenarium (Pl. 3, fig. 8). In the early adult whorls they are thinner, irregularly folded, but commonly overlap one another, especially away from the center of the shell. The lower margins of the septa in the early adult region are folded slightly up to one-half chamber height and the septa do not always parallel the axis of coiling. In the last volution the septa are more numerous, more tightly folded and overlap each other across the shell. Septal pores are commonly seen in slightly oblique sections and are distributed evenly over the entire septal face (Pl. 3, fig. 2).

The tunnel is narrow in the juvenarium (tunnel angle 17°), where it is well defined by chomata. In later volutions it is not possible to trace the tunnel with any degree of accuracy but it apparently widens, having angles of 25° or 30°.

Discussion.—*Pseudoschwagerina tumidosus* is

TABLE OF MEASUREMENTS

YPM specimens

	Volution	20760	20759	20761	20758	20757
radius vector	0	.12mm	.13mm	.09mm	.13mm	.11mm
	1	.20	.21	.18	.30	.45
	2	.38	.35	.30	.55	.70
	3	.64	.90	.60	.80	1.55
	4	1.12	2.00	1.10	2.00	2.20
	5	1.85	2.60	1.90	3.10	—
	6	2.30	—	—	—	—
half length	0	.20mm	.13mm	.09mm		
	1	.40	.20	.35	11	17
	2	.70	.70	.60	24	20
	3	.90	1.20	1.20	*27	19
	4	1.80	2.00	2.50	19	18
	5	3.50	3.40	4.25	20	18
	6	5.50?	4.50?	7.00	—	29
form ratio	1	2.0	1.0	2.0		
	2	1.8	2.0	2.0		
	3	1.4	2.2	2.0		
	4	1.6	2.2	2.3		
	5	1.9	1.7	2.2		
	6	2.4	1.7	2.8		
tunnel angle	1	17°	17°	15°		
	2	17	18	20		
	3	25	22	—		
	4	30	—	—		
	5	—	—	—		
	6	—	—	—		
wall thickness	0	.03mm	.03mm	.03mm		
	1	.04	.03	.03		
	2	.06	.09	.09		
	3	.08	.10	.09		
	4	.09	.09	.04		
	5	.10	.08	.10		
	6	.10	.09	.12		

rare in my collections from the Glass Mountains but those specimens examined suggest it is a distinct species from others in the collections. This species compares most closely with *P. texana* var. *ultima* Dunbar and Skinner but differs in certain important aspects. The inflation after the juvenarium is more pronounced and the septa are more irregularly folded in the early adult whorls in this species than in *P. texana* var. *ultima.*

P. beedei Dunbar and Skinner, and *P. texana* Dunbar and Skinner are smaller and less elongate than this species. *P. uddeni* (Beede and Kniker) and *P. robusta* (Meek) are more inflated and have smaller juvenaria. *P. convexa* Thompson is similar in respect to the juvenarium, but differs markedly in the adult stages by having more regularly, tighter, and more highly folded septa and a less pronounced inflation.

YPM 20759 and YPM 20760 differ from YPM 20761 in the septal folding in the early adult region, mature form ratio, and the size of the proloculus. As these may represent slight genetic differences in a population, these specimens are included in this species. Certainly the general form of these shells suggests a close taxonomic relationship and their stratigraphic distribution suggests an approximate age equivalence. This species takes its name from the Latin, *tumidosus,* meaning swollen, and refers to the shape of shell.

Occurrence.—Lenoxhills formation in the western Glass Mountains, Tex.

Holotype.—YPM 20760, Yale Peabody Museum, illustrated Pl. 3, fig. 8; Lenoxhills formation, Dugout Mountain, Tex.

Paraschwagerina plena, n. sp.

Pl. 4, figs. 4, 6–8

Description.—This inflated species commonly attains a length of 10 mm and a diameter of 5 mm in six volutions. The highly inflated central portion of the shell and the nearly straight lateral slopes tapering toward acutely rounded to pointed poles are characteristic of this species (Pl. 4, fig. 4, 7, 8).

In specimens examined the proloculi are spherical and small, ranging between 0.04 to 0.06 mm outside diameter. The first two or three whorls are greatly elongate along the axis of coiling and have form ratios of 3.3. After the shell reaches a length of 0.09 or 1.00 mm, it rapidly expands for two volutions with form ratios decreasing to 1.7. The last one or two volutions show a decline in chamber height and a slight elongation along the axis, this increases the form ratio to 2.0. Each chamber is nearly constant in height and shows little change laterally toward the poles. The lateral slopes are generally highly convex in the inflated portion of the shell and become either straight or slightly concave in the extended portion of the mature region.

The wall is composed of a tectum and a well-defined coarse keriotheca and increases gradually from 0.005 mm thick in the proloculus to 0.10 mm in the sixth whorl. The wall remains of constant thickness from the center of the shell nearly to the poles. The septa are strongly folded throughout the shell. The early or juvenile whorls have high septal folds reaching to the top of the low chambers. The inflated whorls show high but irregular septal folds and the outer one

TABLE OF MEASUREMENTS

YPM specimens

	Volution	20725	20723	20722
radius vector	0	.04mm	.05mm	.06mm
	1	.09	.09	.11
	2	.13	.15	.25
	3	.40	.32	.75
	4	.95	.94	1.40
	5	1.60	1.70	2.00
	6	2.30	—	2.50?
half length	1	.12mm	.20mm	.29mm
	2	.42	.50	.65
	3	.95	.80	1.20
	4	1.70	1.70	2.20
	5	2.90	2.95	3.70
	6	4.50	—	5.00
form ratio	1	1.3	2.1	2.6
	2	3.2	3.3	2.6
	3	2.4	2.5	1.6
	4	1.8	1.8	1.6
	5	1.8	1.7	1.8
	6	2.0	—	2.0
tunnel angle	1	35°	28°	29°
	2	38	32	—
	3	—	—	—
	4	—	—	—
	5	—	—	—
	6	—	—	—
wall thickness	0	.005mm	.007mm	.009mm
	1	.004	.009	.008
	2	.008	.02	.01
	3	.01	.04	.01
	4	.04	.07	.04
	5	.08	.11	.10
	6	.10	—	—

or two mature whorls indicate a return to closely spaced, regular septal folds.

The tunnel is wide in the juvenarium, measuring 30°, but it cuts few septa in the inflated and mature portions of the shell and can not be traced in this outer region. Rudimentary chomata in the juvenarium are thin and may be lacking in a few specimens. The rest of the shell lacks chomata. Secondary deposition is apparently rare in this species; Pl. 4, fig. 8, shows secondary deposition on the septa only in the mature region; other specimens show no deposition.

Discussion.—Paraschwagerina plena, n. sp., is structurally between a typical *Paraschwagerina* and a typical *Pseudoschwagerina.* The inflation of the chambers in the early adult shell and their reduction in height in the late adult shell compare favorably with *Pseudoschwagerina.* However, the elongate juvenarium with closely folded septa and only rudimentary chomata, and the well-developed although irregular septal foldings in the adult shell are more suggestive of *Paraschwagerina. P. plena* is similar to *P. yabei* (Staff), but *P. plena* has highly folded septa throughout the shell and differs in size and shape. Both of these species occur in rocks younger than Wolfcampian and apparently are the aberrant continuation of this lineage into the Middle Permian. *Paraschwagerina acuminata* Dunbar and Skinner is less inflated with more evenly folded septa throughout the shell; *P. kansasensis* (Beede and Kniker) is more globose and has more regularly folded septa; and *P. gigantea* (White) is longer and less inflated and has more regular septal folds in comparison to *P. plena.*

The species takes its name from the Latin *plena,* full or plump, and refers to the greatly inflated volutions of this species.

Occurrence.—Lower part of the Leonard formation in the Lenox Hills and the Lenoxhills formation in the Hess ranch horst.

Holotype.—YPM 20722, Yale Peabody Museum; illustrated Pl. 4, fig. 8; from lower part of Leonard formation, Lenox Hills.

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EXPLANATION OF PLATES

All figures × 10

Plate 1

Figs. 1–3, 5.—*Triticites comptus*, n. sp., Gaptank formation:
 1. Axial section, "grey limestone," Wolf Camp Hills, YPM 20555.
 2. Axial section, 5 miles northeast of Wolf Camp Hills, YPM 20550.
 3. Sagittal section, "grey limestone", Wolf Camp Hills, YPM 20552.
 5. Axial section, holotype, "grey limestone," Wolf Camp Hills, YPM 20551.

Figs. 4, 6, 7, 10, 11.—*Schwagerina tersa*, n. sp., Leonard and Lenoxhills formation:
 4. Axial section, southwestern end of Dugout Mountains, YPM 20680.
 6. Axial section of holotype, 2½ miles west of the Wolf Camp Hills, one-third the distance up the slope, YPM 20684.
 7. Axial section, 2½ miles northeast of Wolf Camp Hills, YPM 20681.
 10. Sagittal section, 2½ miles west of Wolf Camp Hills, one-third the distance up the slope, YPM 20679.
 11. Axial section, 2½ miles northeast of Wolf Camp Hills, YPM 20682.

Figs. 8, 9, 12, 13.—*Schwagerina pugunculus*, n. sp., Nealranch formation, Wolf Camp Hills:
 8. Axial section, YPM 20721.
 9. Sagittal section, YPM 20720.
 12. Axial section, YPM 20719.
 13. Axial section of holotype, YPM 20716.

Plate 2

Figs. 1–6.—*Schwagerina lineanoda*, n. sp., Lenoxhills formation:
 1. Axial section, southwest end of Dugout Mountain, YPM 20677.
 2. Axial section, north of Wolf Camp Hills, YPM 20676.
 3. Axial section of holotype, north of Wolf Camp Hills, YPM 20675.
 4. Axial section, north of Wolf Camp Hills, YPM 20674.
 5. Tangential section, north of Wolf Camp Hills, YPM 20673.
 6. Sagittal section, north of Wolf Camp Hills, YPM 20678.

Figs. 7–12.—*Schwagerina dispansa*, n. sp., Lenoxhills formation north of the Wolf Camp Hills:
 7. Axial section of holotype, YPM 20628.
 8. Axial section, photographed with oblique lighting, YPM 20629.
 9. Sagittal section, YPM 20624.
 10. Tangential section showing a single false cuniculus resorbed by tunnel, YPM 20627.
 11. Axial section, YPM 20625.
 12. Axial section, YPM 20626.

Plate 3

Figs. 1–3, 8.—*Pseudoschwagerina tumidosus*, n. sp., Lenoxhills formation.
 1. Oblique section, Hess ranch horst, YPM 20751.
 2. Slightly oblique section, Hess ranch horst, YPM 20761.
 3. Axial section, Dugout Mountain, YPM 20759.
 8. Axial section of holotype, Dugout Mountain, YPM 20760.

Figs. 4–7, 9.—*Schwagerina extumida* n. sp., Lenoxhills formation, Hess ranch horst.
 4. Sagittal section, YPM 20651.
 5. Axial section, YPM 20650.
 6. Axial section, YPM 20648.
 7. Axial section, YPM 20646.
 9. Axial section, holotype, YPM 20649.

Plate 4

Figs. 1–3, 5.—*Schwagerina crebrisepta*, n. sp., Lenoxhills formation in the Lenox Hills:
 1. Axial section, YPM 20632.
 2. Axial section, YPM 20631.
 3. Axial section, holotype, YPM 20634.
 5. Sagittal section, YPM 20633.

Figs. 4, 6–8.—*Paraschwagerina plena*, n. sp., lower part of the Leonard formation, Lenox Hills:
 4. Axial section, YPM 20723.
 6. Oblique section, YPM 20726.
 7. Axial section, YPM 20725.
 8. Axial section, holotype, YPM 20722.

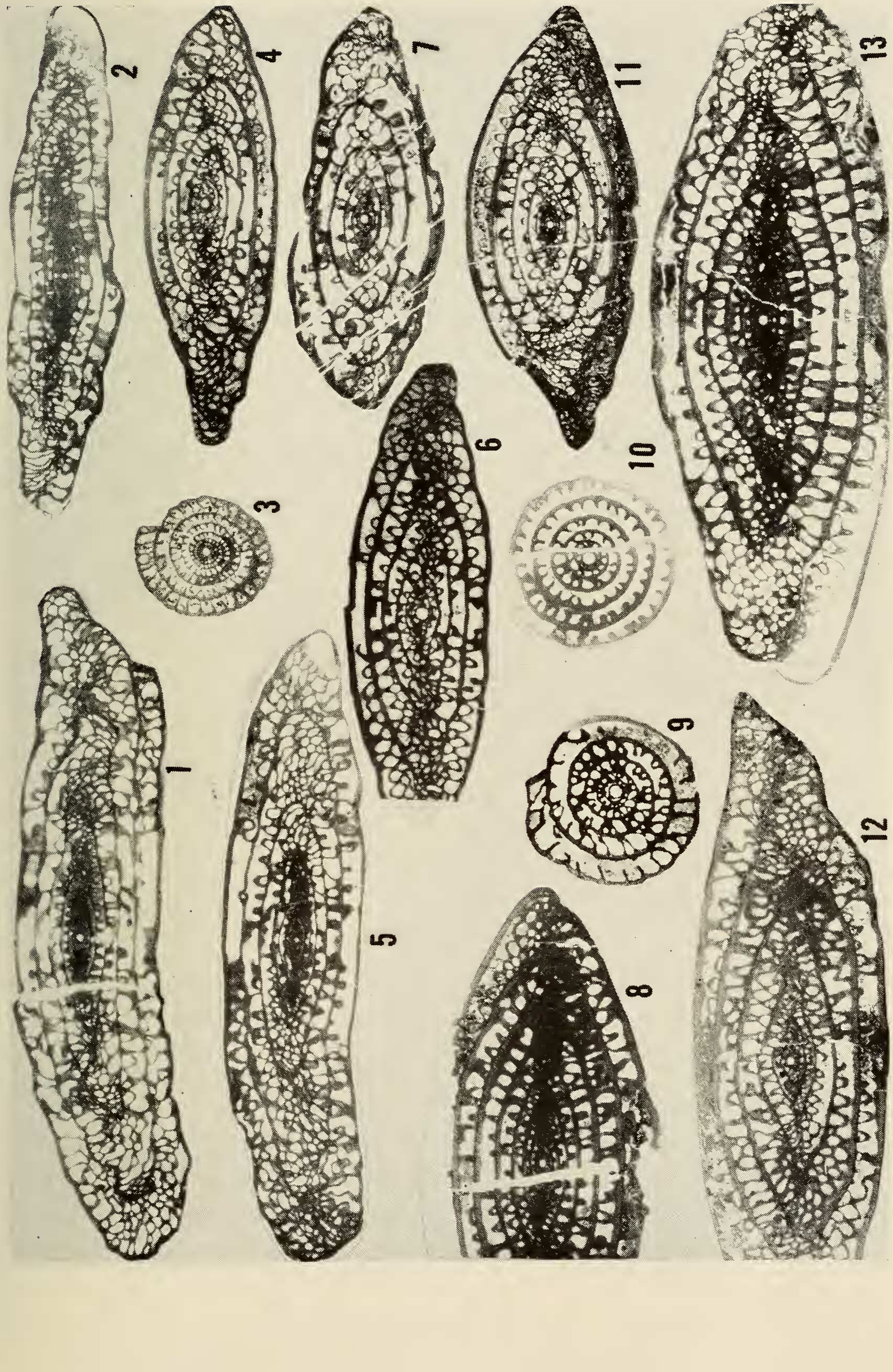

Plate 1.—(For explanation see p. 312).

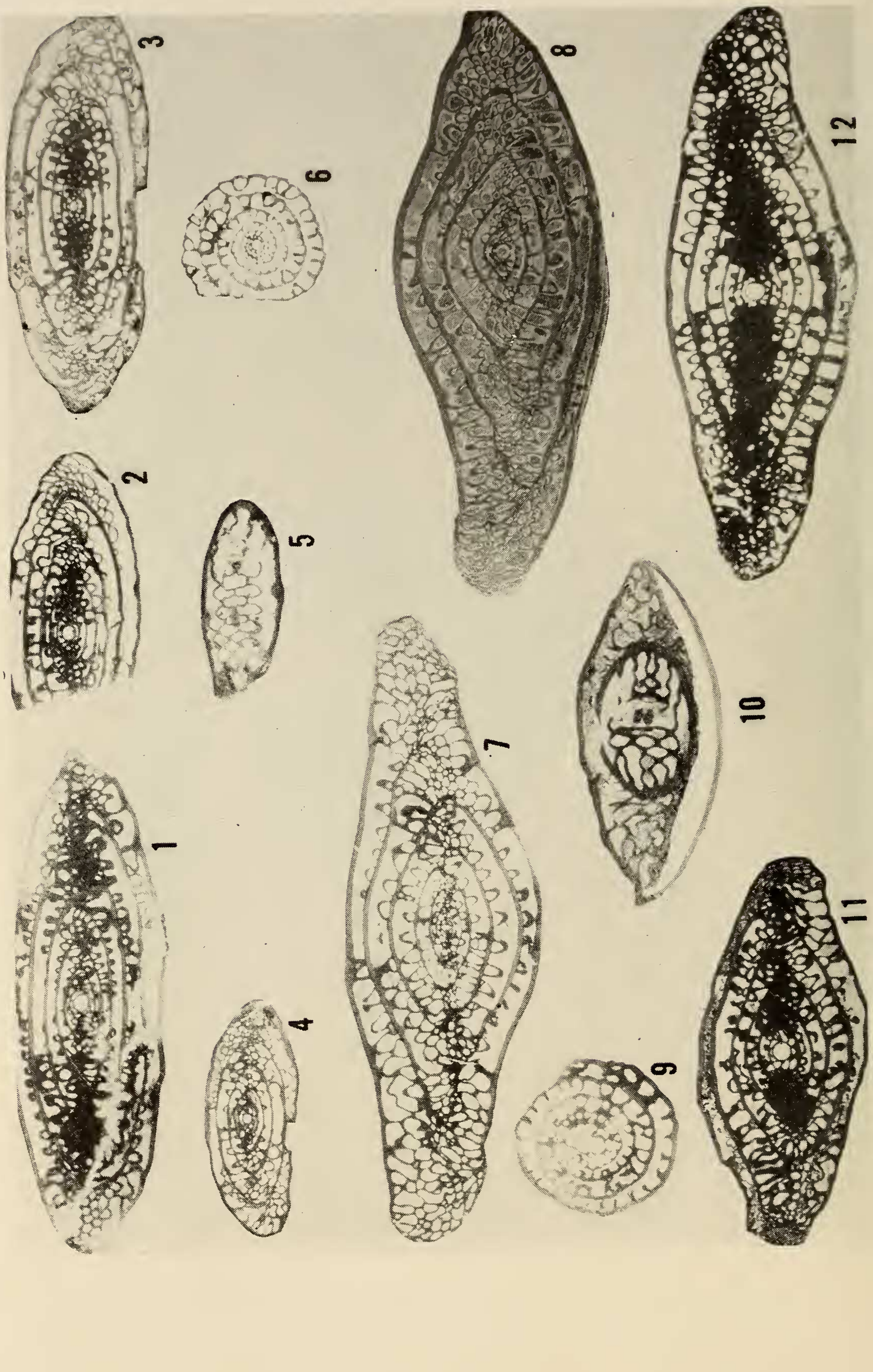

PLATE 2.—(For explanation see p. 312).

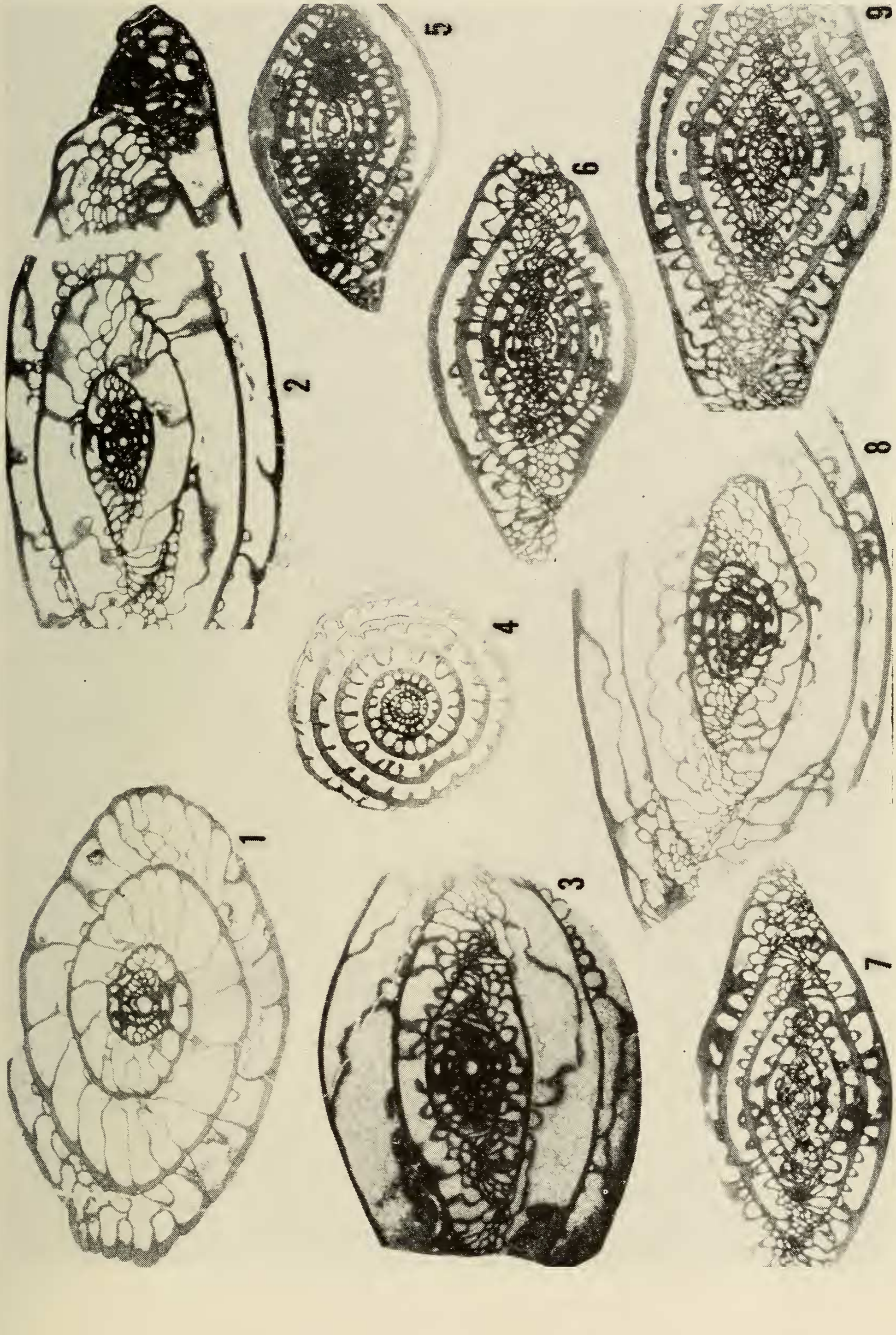

Plate 3.—(For explanation see p. 312).

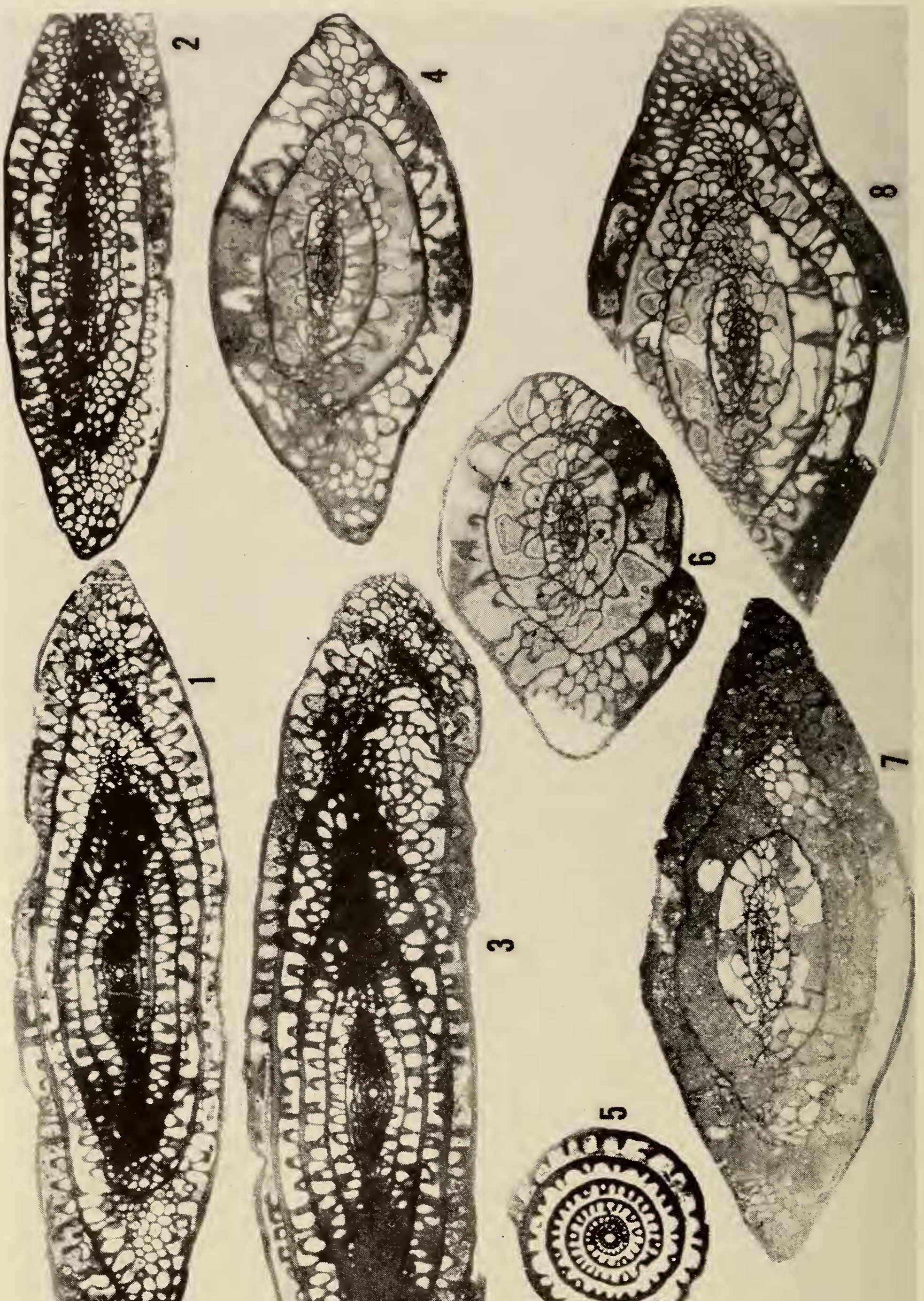

PLATE 4.—(For explanation see p. 312).